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An AR-Guided System for Fast Image-Based Modeling of Indoor Scenes

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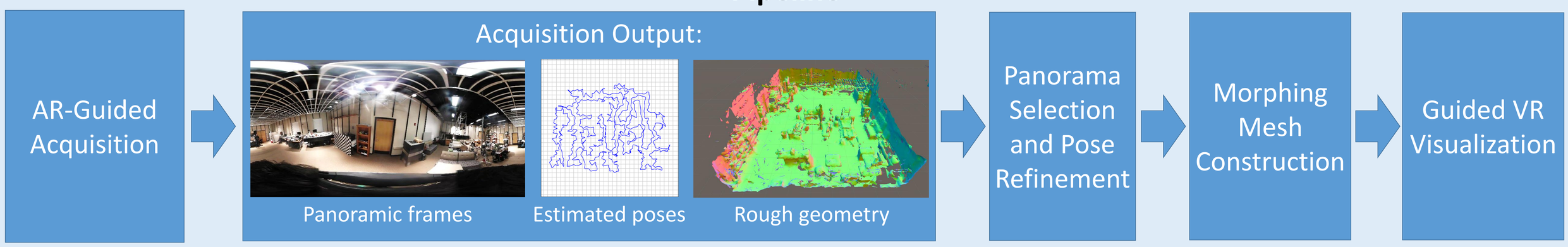
We propose an Image-Based Modeling and Rendering (IBMR) system that allows a novice user to acquire a large indoor space in minutes, in support of interactive photorealistic visualization. During acquisition, an AR interface guides the user to capture sufficient images efficiently. During rendering, a VR interface guides the user to maximize visualization fidelity.

Pipeline



AR-Guided Acquisition

Figure 1: The user walks through the scene while wearing an AR HMD enhanced with a panoramic video camera.

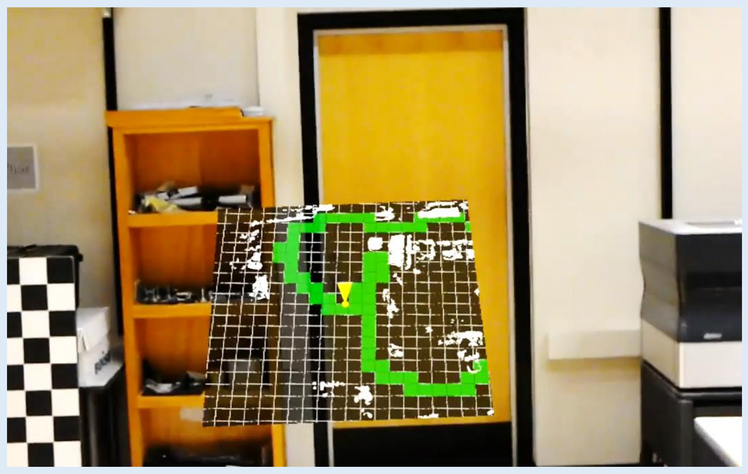


Figure 2: The AR interface shows a 2D grid of a dynamically generated floor plan, which appears as a map floating in front of the user.

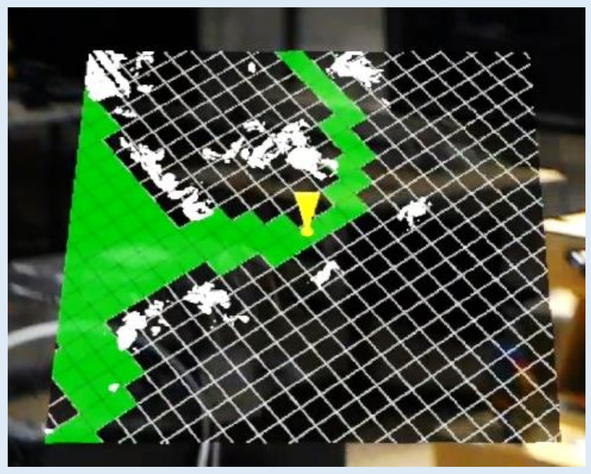


Figure 3: Unexplored (black) and explored (green) regions, floor obstacles (white), and the user's viewpoint (yellow). Grid cell size = 0.5m.

Panorama Selection

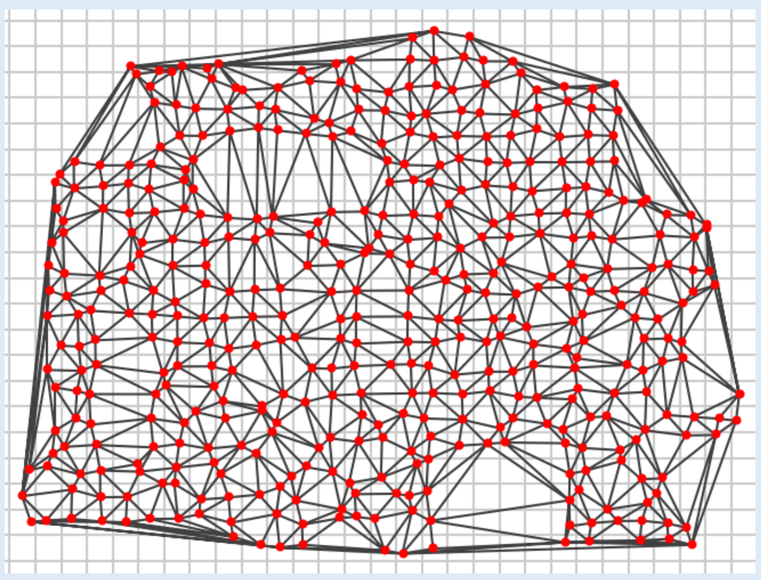


Figure 4: Panoramas (red circles) selected based on estimated AR HMD poses by proximity to traversed grid cell centers and by low rotational velocity. Panorama triplets (gray triangles) defined by Delaunay triangulation.

Pose Refinement

Figure 5: Feature matches between adjacent panoramas, after RANSAC outlier removal, used in bundle adjustment to refine estimated panorama poses are refined via bundle adjustment with pairwise matches.

Morphing Mesh Construction

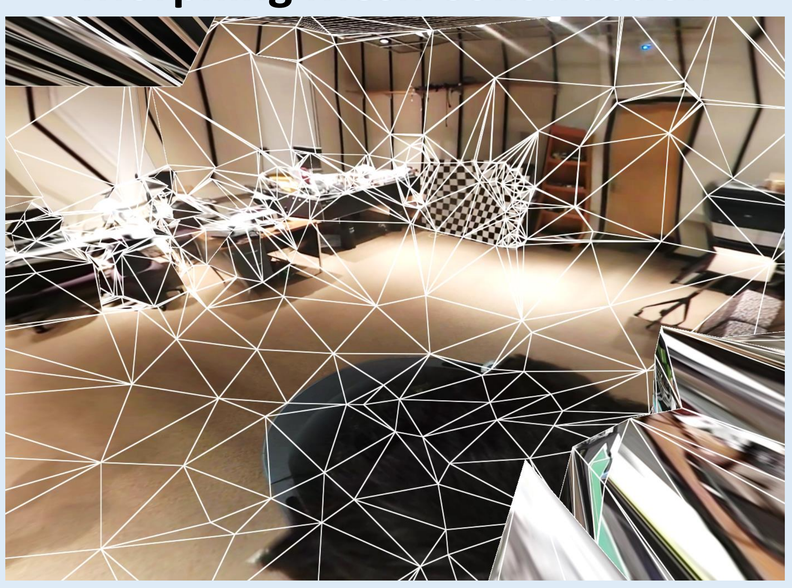


Figure 6: Third-person view of morphing mesh for a single panorama triplet. For each triplet, the set of common feature matches is expanded with 3D surface samples extracted from the rough geometry captured during acquisition.

Real-time VR Visualization

Figure 7: Image-based rendering of acquired scene. Top row: VR visualization at acquisition location. Bottom row: VR visualization between acquisition locations.

Figure 8: Left: VR map to guide user (red dot) to nearby panoramas (green dots), for highest fidelity. Right: VR map as seen by user.

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Opinions, interpretations, conclusions and recommendations are those of the authors and are not necessarily endorsed by the NSF.